Lab_06_NeuralBasic.m

```
%% Machine Learning
% Lab 6: Neural Network Classification
% ——— Handwritten Digits ———
%{
For this exercise, you will use neural networks to
recognize handwritten digits (from 0 to 9). Automated handwritten digit
recognition is widely used today — from recognizing zip codes (postal codes)
on mail envelopes to recognizing amounts written on bank checks.
%}

%% Initialization
clear ; close all; clc

%% Setup the parameters you will use for this exercise
input_layer_size  = 400;  % 20x20 Input Images of Digits
hidden_layer_size = 25;   % 25 hidden units
num_labels = 10;          % 10 labels, from 1 to 10
                          % (note that we have mapped "0" to label 10)

%% ========== Part 1: Loading and Visualizing Data =============
%  We start the exercise by first loading and visualizing the dataset.
%  You will be working with a dataset that contains handwritten digits.
%

% Load Training Data
fprintf('Loading and Visualizing Data ...\n')

load('ex3data1.mat');
m = size(X, 1);

% Randomly select 100 data points to display
sel = randperm(size(X, 1));
sel = sel(1:100);

displayData(X(sel, :));

fprintf('Program paused. Press enter to continue.\n');
pause;

%% ================ Part 2: Loading Pameters ================
% In this part of the exercise, we load some pre-initialized
% neural network parameters.

fprintf('\nLoading Saved Neural Network Parameters ...\n')

% Load the weights into variables Theta1 and Theta2
load('ex3weights.mat');

%% ================= Part 3: Implement Predict =================
%  After training the neural network, we would like to use it to predict
%  the labels. You will now implement the "predict" function to use the
%  neural network to predict the labels of the training set. This lets
%  you compute the training set accuracy.

pred = predict(Theta1, Theta2, X);

```

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fprintf('\nTraining Set Accuracy: %f\n', mean(double(pred == y)) * 100);

fprintf('Program paused. Press enter to continue.\n');
pause;

%  To give you an idea of the network's output, you can also run
%  through the examples one at the a time to see what it is predicting.

%  Randomly permute examples
rp = randperm(m);

for i = 1:m
    % Display
    fprintf('\nDisplaying Example Image\n');
    displayData(X(rp(i), :));

    pred = predict(Theta1, Theta2, X(rp(i),:));
    fprintf('\nNeural Network Prediction: %d (digit %d)\n', pred, mod(pred, 10));

    % Pause with quit option
    s = input('Paused - press enter to continue, q to exit:','s');
    if s == 'q'
      break
    end
end
```

predict.m

```
function p = predict(w1, w2, X)
%PREDICT Predict the label of an input given a trained neural network
% Useful values
m = size(X, 1);
num_labels = size(w2, 1);

p = zeros(size(X, 1), 1);

a1 = [ones(m, 1) X];
z2 = a1*w1';
a2 = [ones(size(z2, 1), 1) sigmoid(z2)];
z3 = a2*w2';
a3 = sigmoid(z3);

[p_max, p] = max(a3, [], 2);

end
```